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[ITEM]	SPECIFICATION	1
[ITEM]	DRAWINGS	1
[ITEM]	ABSTRACT	1
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[NAME OF DOCUMENT] Specification

[TITLE OF THE INVENTION] LIGHT EMITTING DEVICE

[CLAIMS]

[Claim 1] A light emitting device characterized by comprising:

a pair of metal layers provided respectively on the upper surface and lower surface of an insulating base;

a plurality of light emitting elements arranged on the metal layer provided on the upper surface of the insulating base; and

a metal connection that connects the pair of metal layers to each other at a position where any of the plurality of light emitting elements is disposed.

[Claim 2] The light emitting device according to claim 1, wherein the metal connection is a through-hole plating.

[Claim 3] The light emitting device according to claim 2, wherein the through-hole plating has a hollow portion filled with metal.

[Claim 4] The light emitting device according to claim 1, wherein:

the plurality of light emitting elements comprise a first light emitting element configured to emit light at a predetermined heat amount and a second light emitting element configured to emit light at a lower heat amount than the predetermined heat amount; and

the metal connection connects the pair of metal layers to each other at a position where the first light emitting

element has been disposed.

[Claim 5] The light emitting device according to claim 1, wherein the plurality of light emitting elements comprise one blue light emitting element, one or more green light emitting elements, and two or more red light emitting elements.

[Claim 6] The light emitting device according to claim 1, wherein the plurality of light emitting elements comprise one blue light emitting element, two green light emitting elements, and two red light emitting elements.

[Claim 7] A light emitting device characterized by comprising:

a substrate comprising a plurality of leads provided on an insulating base;

a plurality of light emitting elements arranged on a base line along a surface of the substrate in a predetermined direction; and

a plurality of bonding wires configured to connect the plurality of light emitting elements to the plurality of leads in the predetermined direction or on one side relative to the base line.

[Claim 8] The light emitting device according to claim 7, wherein the substrate comprises: a reflection case having an opening provided on a side thereof on which the plurality of light emitting elements are arranged, said opening being configured to surround the plurality of light emitting elements and being positioned eccentrically toward the plurality of bonding wires; and a seal member comprising a

light transparent material configured to seal the plurality of light emitting elements and to fill the opening in the reflection case.

[Claim 9] The light emitting device according to claim 7, wherein:

the plurality of light emitting elements comprise a first light emitting element having first and second electrodes on its light emitting face side and a second light emitting element having a first electrode on its light emitting face side and a second electrode on its side remote from the light emitting face;

the first light emitting element is arranged at the end of the array of the plurality of light emitting elements and at a portion other than the end of the array; and

in the first light emitting element arranged at the end of the array, the first electrode and the second electrode are disposed in a position perpendicular to the predetermined direction, while in the first light emitting element arranged at the portion other than the end of the array, the first electrode and the second electrode are disposed in the predetermined direction.

[Claim 10] The light emitting device according to claim 7, wherein the substrate is a printed circuit board with the plurality of leads provided on the insulating base by a circuit printing method.

[Claim 11] The light emitting device according to claim 7, wherein the substrate has a lead frame structure formed by

placing a lead frame corresponding to the plurality of leads within a mold and pouring an insulating material into the mold.

[Claim 12] The light emitting device according to claim 7, wherein the plurality of light emitting elements comprise one blue light emitting element, one or more green light emitting elements, and two or more red light emitting elements.

[Claim 13] The light emitting device according to claim 7, wherein the plurality of light emitting elements comprise one blue light emitting element, two green light emitting elements, and two red light emitting elements.

[Claim 14] A light emitting device characterized by comprising:

a pair of metal layers provided respectively on the upper surface and lower surface of an insulating base;

a plurality of light emitting elements arranged on a base line along a surface of the metal layer in a predetermined direction provided on the upper surface of the insulating base;

a metal connection configured to connect the pair of metal layers to each other at a position where any of the plurality of light emitting elements is disposed; and

a plurality of bonding wires configured to connect the plurality of light emitting elements to the metal layer, provided on the upper surface of the insulating base, in the predetermined direction or on one side relative to the base line.

[Claim 15] The light emitting device according to claim

14. wherein the substrate comprises a reflection case having an opening provided on a side thereof on which the plurality of light emitting elements are arranged, said opening being configured to surround the plurality of light emitting elements and being positioned eccentrically toward the plurality of bonding wires; and a seal member comprising a light transparent material configured to seal the plurality of light emitting elements and to fill the opening in the reflection case.

[Claim 16] The light emitting device according to claim 14, wherein the plurality of light emitting elements comprise one blue light emitting element, one or more green light emitting elements, and two or more red light emitting elements.

[Claim 17] The light emitting device according to claim 14, wherein the plurality of light emitting elements comprise one blue light emitting element, two green light emitting elements, and two red light emitting elements.

[Claim 18] A light emitting device for driving a plurality of LED chips disposed in an array to emit a mixed light composed of lights emitted from the plurality of LED chips, said light emitting device being characterized by comprising:

an LED chip connection lead provided on the upper surface of an insulating base;

a power supply connection lead provided on the lower surface of the insulating base; and

a link lead configured to connect the LED chip connection

lead to the power supply connection lead between the upper and lower surfaces of the insulating base, wherein

the LED chip connection lead comprises: a plurality of separate leads connected respectively to the plurality of LED chips; and a common lead connected to the plurality of LED chips by a common connection, the common lead being loaded with the plurality of LED chips and configured to absorb heat generated from the plurality of LED chips.

[Claim 19] The light emitting device according to claim 18, wherein:

the common lead has an elongated region having predetermined width and length sufficient to be loaded with the plurality of LED chips;

the plurality of LED chips comprise a first plurality of LED chips having positive and negative electrodes on a light emitting face thereof and a second plurality of LED chips having positive and negative electrodes on a light emitting face and a substrate side thereof; and

the first and second pluralities of LED chips are alternately loaded into the elongated region of the common lead.

[Claim 20] The light emitting device according to claim 19, wherein the link lead comprises a plurality of through-hole platings configured to connect the common lead to the power supply connection lead at a position just under the plurality of first LED chips.

[Claim 21] The light emitting device according to claim

18, wherein the link lead comprises a plurality of through-hole platings configured to connect the plurality of separate leads to the power supply connection lead.

[Claim 22] The light emitting device according to claim 18, wherein the power supply connection lead comprises: a common lead connected to either a power supply or a ground; and a plurality of separate leads connected to the ground or the power supply.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical Field of the Invention]

The invention relates to a light emitting device suitable for use, for example, as white light sources for backlight or frontlight in liquid crystal panels, and more particularly to a light emitting device in which heat radiating properties are homogenized, heat radiation efficiency is improved, and a compact structure is obtained and, thus, the color balance can be improved and unfavorable phenomena such as lowering in the output of light emitting elements and shortening of the service life can be avoided.

[0002]

[Prior Art]

A conventional light emitting device for backlight in full color liquid crystal panels is disclosed, for example, in Japanese Patent Laid-Open No. 329044/1999.

[0003]

This light emitting device comprises: an LED chip array

comprising an LED for red (R), an LED for green (G), and an LED for blue (B); and a light guide section provided such that light from the LED chip array enters therein through an incident face and is guided so as to propagate through the inside of the light guide section, thereby permitting planar backlight to be emitted from the light guide section through an outgoing face. Each of the LEDs for respective colors R, G, and B has a narrow-band emission spectrum. Therefore, upon light emission from each LED for R, G, and B, lights of R, G, and B from the respective LEDs can be mixed together to supply white backlight to a liquid crystal display panel.

[0004]

[Problems to be Solved by the Invention]

According to the conventional light emitting device, since radiation characteristics of each light emitting device varies from position to position, the speed of deterioration varies for each light emitting element. This tends to change the color balance over time. Light emitting elements having poor radiation characteristics can cause, for example, lowered power output and have shortened service life, which is undesirable.

Some light emitting elements, such as G and B, have both positive and negative electrodes on light emitting faces thereof, which can increase the number of bonding wires coupled to the light emitting elements. With more bonding wires coupled to the light emitting elements, a compact packaging arrangement is difficult to achieve.

[0005]

Accordingly, it is an object of the invention to provide a light emitting device in which homogeneous radiation characteristics can be obtained and, thus, no significant change balance in color results from the elapse of time.

It is another object of the invention to provide a light emitting device in which improved radiation efficiency is obtained and unfavorable phenomena such as lowering in power output and shortening of service life of light emitting elements can be avoided.

It is a further object of the invention to provide a light emitting device having a compact structure.

[0006]

[Means for Solving the Problems]

The above object of the invention can be attained by a light emitting device characterized by comprising: a pair of metal layers provided respectively on the upper surface and lower surface of an insulating base; a plurality of light emitting elements arranged on the metal layer provided on the upper surface of the insulating base; and a metal connection that connects the pair of metal layers to each other at a position where any of the plurality of light emitting elements is disposed.

According to this construction, heat generated from the plurality of light emitting elements is released through the metal layer provided on the upper surface of the insulating base into the air, and, in addition, is transferred through

the metal connection to the metal layer provided on the lower surface of the insulating base and is then released into the air. Further, since the radiating surface is increased, the radiation efficiency can be improved.

[0007]

The above object of the invention can be attained by a light emitting device characterized by comprising: a substrate comprising a plurality of leads provided on an insulating base; a plurality of light emitting elements arranged on a base line along a surface of the substrate in a predetermined direction; and a plurality of bonding wires configured to connect the plurality of light emitting elements to the plurality of leads in the predetermined direction or on one side relative to the base line.

According to this construction, in the connection of the plurality of light emitting elements to the plurality of leads through bonding wires, this connection is carried out in such a state that the bonding wire has been rendered eccentric. This can reduce the size of the device in a direction perpendicular to a direction in which the plurality of light emitting elements are arrayed. The plurality of light emitting elements comprise a first light emitting element having first and second electrodes on its light emitting face side and a second light emitting element having a first electrode on its light emitting face side and a second electrode on its side remote from the light emitting face. The term "light emitting element" as used herein means a bared chip, such as

LED having first and second electrodes. The term "substrate" refers to, for example, a printed circuit board formed by providing leads connected to first and second electrodes on a base by a circuit printing method, and a substrate having a lead frame structure formed by placing a lead frame, corresponding to leads connected to first and second electrodes, within a mold and pouring an insulating material into the mold.

[0008]

The above object of the invention can be attained by a light emitting device characterized by comprising: a pair of metal layers provided respectively on the upper surface and lower surface of an insulating base; a plurality of light emitting elements arranged on a base line along a surface of the metal layer in a predetermined direction provided on the upper surface of the insulating base; a metal connection configured to connect the pair of metal layers to each other at a position where any of the plurality of light emitting elements is disposed; and a plurality of bonding wires configured to connect the plurality of light emitting elements to the metal layer, provided on the upper surface of the insulating base, in the predetermined direction or on one side relative to the base line.

According to this construction, heat generated from the plurality of light emitting elements is released through the pair of metal layers provided respectively on the upper and lower surfaces of the insulating base into the air. In

addition, in the connection of the plurality of light emitting elements to the plurality of leads through bonding wires, this connection is carried out in such a state that the bonding wire has been rendered eccentric. This can reduce the size of the device in a direction perpendicular to a direction in which the plurality of light emitting elements are arrayed.

[0009]

The above object of the invention can be attained by a light emitting device for driving a plurality of LED chips disposed in an array to emit a mixed light composed of lights emitted from the plurality of LED chips, said light emitting device being characterized by comprising: an LED chip connection lead provided on the upper surface of an insulating base; a power supply connection lead provided on the lower surface of the insulating base; and a link lead configured to connect the LED chip connection lead to the power supply connection lead between the upper and lower surfaces of the insulating base, wherein the LED chip connection lead comprises: a plurality of separate leads connected respectively to the plurality of LED chips; and a common lead connected to the plurality of LED chips by a common connection, the common lead being loaded with the plurality of LED chips and configured to absorb heat generated from the plurality of LED chips.

According to this construction, heat generated from the plurality of LED chips is released, through a common lead in the LED chip connection lead provided on the upper surface of

the insulating base, into the air, and, in addition, is transferred through the link lead, to the power supply connection lead provided on the lower surface of the insulating base, and is then released into the air. Further, since the radiating surface is increased, the radiation efficiency can be improved.

[0010]

[Embodiments of the Invention]

Fig. 1 is a diagram showing a light emitting device according to a first embodiment of the invention, wherein Fig. 1 (a) is a diagram showing the upper surface of the light emitting device, Fig. 1 (b) a cross-sectional view taken on line A-A of Fig. 1 (a), Fig. 1 (c) a diagram showing a metal pattern provided on the upper surface of the light emitting device, and Fig. 1 (d) a diagram showing the lower surface of the light emitting device. For the facilitation of understanding, in Fig. 1 (a), a case and a filling member are not shown, and, in Fig. 1 (c), a resin is not shown. The light emitting device 1 comprises a printed circuit board 2A on which a metal pattern to be loaded with LED has been printed. A plurality of LEDs 3 (3R, 3G, 3B) are disposed in an array on an upper surface 2a of the printed circuit board 2A. A case 4 having an opening 4a provided so as to surround the plurality of LEDs 3 is provided. A filling member 5 of a transparent epoxy resin seals the plurality of LEDs 3 and fills the opening 4a in the case 4.

[0011]

The printed circuit board 2A has a base 2 formed of a material having heat resistance and high white reflectance, for example, a glass-epoxy resin containing a white colorant having high white reflectance. The printed circuit board 2A also has a metal pattern. The metal pattern comprises separate leads 6R, 6G, 6B respectively for red (R), green (G) and blue (B) light elements 3R, 3G and 3B, respectively, printed on the upper surface 2a of the base 2, and a common lead 6C common to the plurality of LEDs 3. A resist 12 is applied to the lower surface 2c of the base 2 and is configured to help prevent short circuiting among leads 6R, 6G, 6B, 6C.

[0012]

The separate leads 6R, 6G, 6B comprise electrode faces $6R_1$, $6G_1$, $6B_1$ provided on the upper surface 2a of the base 2 and connections $6R_2$, $6G_2$, $6B_2$ provided on the lower surface 2c of the base 2. The common lead 6C comprises an electrode face $6C_1$ provided on the upper surface 2a of the base 2, a connection $6C_2$ provided on the side face 2b of the base 2 and a heat radiating section $6C_3$ provided on the lower surface 2c of the base 2. The electrode face $6C_1$ in the common lead 6C has a substantially ⊃ shape. The electrode faces $6R_1$, $6G_1$, $6B_1$ of the separate leads 6R, 6G, 6B provided on the upper surface 2a of the base 2 are connected to the connections $6R_2$, $6G_2$, $6B_2$, which are provided on the lower surface 2c of the base 2. Through-hole platings 9R, 9G, 9B and a solder 11 filled into the through-hole platings 9R, 9G, 9B connect the electrode

faces $6R_1$, $6G_1$, $6B_1$ to the connections $6R_2$, $6G_2$, $6B_2$. The electrode face $6C_1$ in the common lead 6C provided on the upper surface 2a of the base 2 is connected to the heat radiating section $6C_3$ provided on the lower surface 2c of the base 2 via through-hole platings 10R, 10G, 10B, solder 11 filled into the through-hole platings 10R, 10G, 10B, and the connection $6C_2$. The through-hole platings 10R, 10G, 10B are provided just below the LEDs 3G, 3B. The LEDs 3G, 3B can generate a large quantity of heat, among the plurality of LEDs 3. The side face 2b of the base 2 functions as a face for mounting to a light emitting device mount substrate, as will be described in greater detail below. The connections $6R_2$, $6G_2$, $6B_2$, $6C_2$ are connected to a wiring pattern provided on the light emitting device mount substrate.

[0013]

The plurality of LEDs 3 comprise a blue light emitting element 3B disposed in the center of the array of LEDs, two red light emitting elements 3R, 3R disposed respectively on both sides of the blue light emitting element 3B and two green light emitting elements 3G, 3G disposed respectively on outer sides of the red light emitting elements 3R, 3R remote from the blue light emitting element 3B. The red light emitting element or LED 3R is formed of, for example, an AlInGaP-base semiconductor which emits red light. The red LED 3R has a first electrode 3a on its upper surface and a second electrode on its lower surface. The first electrode 3a on the upper surface is electrically connected to the electrode face $6R_1$ of

the separate lead 6R for R using a bonding wire 7R. The second electrode on the lower surface is electrically and mechanically connected to the electrode face $6C_1$ of the common lead 6C and is bonded thereto using a conductive adhesive. The green LED 3G comprises, for example, a GaN-base semiconductor which emits green light. The green LED 3G has a first electrode 3a and a second electrode 3b on its upper surface. The lower surface is mechanically connected to the electrode face $6C_1$ of the common lead 6C with the aid of an adhesive. The first electrode 3a is electrically connected to the electrode face $6G_1$ for G through the bonding wire 7G. The second electrode 3b is electrically connected to the common electrode face $6C_1$ through a bonding wire 8C. The blue LED 3B comprises, for example, a GaN-base semiconductor which emits blue light. The blue LED 3B has a first electrode 3a and a second electrode 3b on its upper surface. The lower surface is mechanically connected to the electrode face $6C_1$ of the common lead 6C with the aid of an adhesive. The first electrode 3a is electrically connected to the electrode face $6B_1$ for B through a bonding wire 7B. The second electrode 3b is electrically connected to the common electrode face $6C_1$ through a bonding wire 8B. The LEDs 3R, 3G, 3B respectively for colors R, G, and B have a light intensity ratio of, for example, 1 : 3 : 1. Therefore, when the number of the blue LEDs 3B used, the number of the red LEDs 3R used, and the number of the green LEDs 3G used are, as described above, for example, one, two, and two, respectively, an optimal intensity ratio of lights R,

G, and B for providing white light through mixing of lights R, G, and B (for example, R : G : B = 2 : 6 : 1) can be realized.

[0014]

The case 4 is formed of a white resin, such as polyphthalamide with a white colorant having high white reflectance incorporated therein, and is mounted on the printed circuit board 2A after mounting the printed circuit board 2A loaded with the LED 3 on the light emitting device mount substrate which will be described later. The opening 4a is provided so that the center of the plurality of LEDs 3 is spaced from the center of the opening 4a by a distance "e" in a direction perpendicular to the aligned array of LEDs 3. The case 4 may also be formed of a resin wherein a white coating is applied onto the opening 4a.

[0015]

In the light emitting device 1 according to the first embodiment, heat from the LEDs 3G, 3B, which generate a relatively large quantity of heat, is released through the common lead 6C provided on the upper surface 2a of the board 2A into the air. The heat is also transferred through the through-hole platings 10R, 10G, 10B and the solder 11 filled into the through-hole platings 10R, 10G, 10B before being released into the air through the common lead 6C provided on the lower surface 2c of the insulated base 2. This allows radiation characteristics among the LEDs 3R, 3G, 3B to be homogenized, and, thus, a change in color balance over time is reduced. Further, unfavorable phenomena, such as lowered power

output and shortened service life, caused by a temperature rise of the LED 3 can be avoided. Since the radiating surface is increased, the radiation efficiency can be improved, which makes it possible to avoid the unfavorable phenomena, such as lowered power output and shortened service life of the LED 3.

In Fig. 1 (a) bonding wires 7R, 7G, 7B, 8R, 8G, 8B extend toward the array of LEDs 3 and are extended from this array toward one side thereof. The plurality of LEDs 3 can be disposed in an eccentric state relative to the opening 4a. This reduces the width W_1 of the opening 4a, and can realize a compact structure such that the width W_2 of the device 1 has been reduced.

In mixing lights R, G, and B to form white light, light can be emitted from the blue LED 3B at full power. Therefore, light can be efficiently emitted.

Since the case 4 can be mounted on the board 2A in a later stage, the draft angle of the opening 4a can be reduced. In addition, any desired shape may be adopted.

Further, since the base 2 and the case 4 are formed of a material having high white reflectance, a high level of reflection can be realized for all emission wavelengths of R, G, and B. Therefore, the emission efficiency can be enhanced, and the power can be reduced. Additionally, the printed circuit board 2A used is one which can be produced in a small size at low cost. This can provide an inexpensive and small-size light emitting device.

[0016]

Fig. 2 is a diagram showing an embodiment of the application of this light emitting device 1 to a backlight apparatus in a full color liquid crystal panel, wherein Fig. 2 (a) is a plan view, Fig. 2 (b) a cross-sectional view taken on line B-B of Fig. 2 (a), and Fig. 2 (c) a cross-sectional view taken on line C-C of Fig. 2 (a). The backlight apparatus 20 comprises: a light emitting device mount substrate 21 provided with an LED drive circuit having a wiring pattern on its surface 21a; a light emitting device 1 provided on one end of the light emitting device mount substrate 21 and having leads 6R, 6G, 6B, 6C connected to a wiring pattern on the light emitting device mount substrate 21; and a light guide section 23 such that light from the light emitting device 1 enters therein through an incident face 23a and is guided so as to propagate through the inside of the light guide section 23, thereby permitting planar white backlight to be emitted from the light guide section 23 through an outgoing face 23b.

[0017]

The light guide section 23 comprises: a light guide plate 230 formed of a transparent material, such as polycarbonate, acryl, or glass; a reflection plate 231 which is provided on the backside 230a of the light guide plate 230, is formed of a white film of polyethylene terephthalate or the like, and functions to reflect light incident to the incident face 23a from the light emitting device 1; and a diffusion plate 232 which is provided on the surface 230b of the light guide plate 230, is formed of, for example, a polycarbonate film having

concaves and convexes in the outgoing face 23b, and is configured to diffuse light which is incident from the light emitting device 1 to the incident face 23a, and is reflected from the reflection plate 231.

[0018]

Fig. 3 shows the LED drive circuit provided on a light emitting device mount substrate 21. As illustrated in the drawing, the LED drive circuit comprises: a power supply 14 configured to apply a drive voltage to the anode of each of LEDs 3R, 3G, 3B; and a control unit 16 which is connected to the cathode of each of LEDs 3R, 3G, 3B respectively through transistors 15R, 15G, 15B and control resistors 17R, 17G, 17R, controls the emission of light from the LEDs 3R, 3G, 3B, and, in addition, controls the power supply 14. According to this construction, the LEDs 3R, 3G, 3B can simultaneously emit light and white backlight can be output. Further, light of any color can be emitted from the LEDs 3R, 3G, 3B by separately emitting light from the LEDs 3R, 3G, 3B, or by varying the luminous intensity from the LEDs 3R, 3G, 3B for the desired color.

[0019]

Fig. 4 shows an assembly comprising the light emitting device 1 and the backlight apparatus 20. In incorporating the light emitting device 1 and the backlight apparatus 20 into the illustrated assembly, the light emitting device 1 is first mounted on the light emitting device mount substrate 21 in such a state that neither the case 4 nor the filling member 5

is provided. Specifically, a wiring pattern 22 provided on the surface 21a of the light emitting device mount substrate 21 is connected to the connections $6R_2$, $6G_2$, $6B_2$, $6C_2$ of the leads 6R, 6G, 6B, 6C in the light emitting device 1 by using a solder 13. Next, the case 4 is bonded to the upper surface 2a of the printed circuit board 2 with the aid of an adhesive, and the filling member 5 hermetically seals the LEDs 3R, 3G, 3D and fills the opening 4a in the case 4. The light guide section 23 is then mounted onto the light emitting device mount substrate 21.

[0020]

The backlight apparatus 20 is configured such that the LEDs 3 for respective colors are densely disposed to create a state close to a point light source. Therefore, white light can be homogeneously diffused within the light guide plate 230. As a result, a diffusion homogeneity of not less than 60% in terms of minimum brightness relative to the maximum brightness can be ensured in the outgoing face 23b of the light guide section 23. This diffusion homogeneity can prevent color shading in full color liquid crystal display panels.

Further, the thickness of the backlight apparatus 20 can be reduced by reducing the width W_1 of the opening 4a in the light emitting device 1.

The light emitting device can be mounted on the light emitting device mount substrate 21 in such a state that the case 4 is not provided. Therefore, the light emitting device can be easily mounted onto the light emitting device mount

substrate 21.

Further, when the light emitting device 1 is mounted onto the light emitting device mount substrate 21, connection is performed by the solder 13 in the connections $6R_2$, $6G_2$, $6B_2$ provided on the lower surface 2c of the board 2A, as well as in the connection $6G_3$ provided on the side face 2b. This can prevent the board 2A from being toppled backward.

[0021]

Fig. 5 shows a backlight apparatus 20, which is an alternative embodiment of the backlight apparatus 20 shown in Fig. 2. This backlight apparatus 20 includes two incident faces 23a of the light guide section 23 provided on one side thereof. One light emitting device 1 is provided on each incident face 23a. The other points are the same as those shown in Fig. 2. According to this backlight apparatus 20, more homogeneous emission characteristics can be realized in the widthwise direction for the backlight apparatus 20.

[0022]

Fig. 6 shows a backlight apparatus 20, which is another alternative embodiment of the backlight apparatus 20 shown in Fig. 2. This backlight apparatus 20 includes incident faces 23a which are provided on both sides of the light guide section 23 and each include one light emitting device 1 provided thereon. The other points are the same as those shown in Fig. 2. According to this backlight apparatus 20, more homogeneous emission characteristics can be realized in the longitudinal direction for the backlight apparatus 20.

[0023]

Fig. 7 is a diagram showing a light emitting device according to a second embodiment of the invention, wherein Fig. 7 (a) is a diagram showing the upper surface of the light emitting device, Fig. 7 (b) a cross-sectional view taken on line D-D of Fig. 7 (a), Fig. 7 (c) a diagram showing a metal pattern provided on the upper surface of the light emitting device, and Fig. 7 (d) a diagram showing the lower surface of the light emitting device. For the facilitation of understanding, in Fig. 7 (a), a case and a filling member are not shown, and, in Fig. 7 (c), a resin is not shown. The light emitting device 1 according to the second embodiment has the same construction as the light emitting device according to the first embodiment, except that the LEDs 3R, 3G, 3B are disposed at the center of the opening 4a in the case 4 and, as shown in Fig. 7 (a), the bonding wires 7R, 7G, 7B and 8R, 8G, 8B are vertically extended. The electrode face $6C_1$ of the common lead 6C in the second embodiment has a substantially H shape.

[0024]

In this second embodiment, as shown in Fig. 7 (a), since the bonding wires 7R, 7G, 7B and 8R, 8G, 8B are vertically extended, the pitch of the LEDs 3R, 3G, 3B in the longitudinal direction can be reduced. Thus, the size in the direction of length L can be reduced.

[0025]

Fig. 8 is a diagram showing a light emitting device

according to a third embodiment of the invention, wherein Fig. 8 (a) is a plan view, Fig. 8 (b) a front view, Fig. 8 (c) a cross-sectional view taken on line E-E of Fig. 8 (a), and Fig. 8 (d) a cross-sectional view taken on line F-F of Fig. 8 (a). For the facilitation of understanding, in Fig. 8 (a), a portion corresponding to the case and the filling member are not shown. This light emitting device 1 according to the third embodiment of the invention has the same construction as the light emitting device according to the first embodiment, except that a substrate 2B having a lead frame structure is used instead of the printed circuit board 2A and a case 4', corresponding to the case 4, is formed of the same material as the base 2.

[0026]

The substrate 2B having a lead frame structure has the case 4' corresponding to the case 4 and, as with the first embodiment, comprises a base 2 formed of a material having heat resistance and high white reflectance. Separate leads 6R, 6G, 6B for respective colors R, G, and B are incorporated into the base 2 when the base 2 is insert molded. A common lead 6C is common to the plurality of LEDs 3. The leads 6R, 6G, 6B, 6C comprise electrode faces $6R_1$, $6G_1$, $6B_1$, $6C_1$, provided on the upper surface 2a of the base 2, and connections $6R_2$, $6G_2$, $6B_2$, $6C_2$ provided on the side face 2b of the base 2. The connection $6R_2$ for R and the connection $6G_2$ for G are extended toward the case 4'. A concave 2d for receiving the connections $6R_2$, $6G_2$, $6B_2$, $6C_2$ is provided in the base 2. The leads 6R, 6G, 6B, 6C

may be formed by placing a lead frame within a mold, pouring a material for the base 2 into the mold to mold the substrate 2B provided with the case 4', cutting the lead frame into a predetermined shape, and then bending the lead frame.

[0027]

When the light emitting device 1 is incorporated into the backlight apparatus as shown in Fig. 2, the connections $6R_2$, $6G_2$, $6D_2$, $6C_2$ provided on the side face 2b of the base 2 provided with the case 4' and the filling member 5 are connected to the wiring pattern provided on the light emitting device mount substrate 21 through a solder, whereby the light emitting device 1 is mounted on the light emitting device mount substrate 21.

[0028]

According to the third embodiment, when the light emitting device 1 is incorporated into the backlight apparatus 20, the post-mounting work of the case 4 after mounting the light emitting device 1 onto the light emitting device mount substrate 21 can be eliminated. Therefore, the light emitting device 1 can be easily mounted onto the light emitting device mount substrate 21.

Further, since the leads 6R, 6G, 6B, 6C in the substrate 2B having a lead frame structure function as a heat sink, a highly heat resistant package can be produced.

[0029]

Light emitting elements, all of which emit an identical color light, may be used as the light emitting elements

mounted on the substrate. Regarding the through-hole plating provided just under light emitting elements which generate a large quantity of heat, one or a plurality of through-hole platings may be provided around the light emitting elements which generate a large quantity of heat.

[0030]

[Effect of the Invention]

As is apparent from the foregoing description, according to the light emitting device of the invention, heat generated from a plurality of light emitting elements are released through a metal layer and metal connections into the air. By virtue of this, when a plurality of light emitting elements are used, radiation characteristics can be homogenized, and, thus, a change in color balance with the elapse of time can be reduced.

Further, since the radiation surface is increased, the radiation efficiency can be improved, and thus, unfavorable phenomena of light emitting elements, such as lowered power output and shortened service life, can be avoided.

Furthermore, in connecting a plurality of light emitting elements to a plurality of leads, this connection is carried out in such a state that the bonding wire has been rendered eccentric. This can reduce the size of the device in a direction perpendicular to a direction in which the plurality of light emitting elements are arrayed.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1]

Fig. 1 is a diagram showing a light emitting device in a first embodiment of the invention, wherein Fig. 1 (a) is a diagram showing the upper surface of the light emitting device, Fig. 1 (b) a cross-sectional view taken on line A-A of Fig. 1 (a), Fig. 1 (c) a diagram showing a metal pattern provided on the upper surface of the light emitting device, and Fig. 1 (d) a diagram showing the lower surface of the light emitting device.

[Fig. 2]

Fig. 2 is a diagram showing an embodiment of the application of the light emitting device in the first embodiment of the invention to a backlight apparatus, wherein Fig. 2 (a) is a plan view, Fig. 2 (b) a cross-sectional view taken on line B-B of Fig. 2 (a), and Fig. 2 (c) a cross-sectional view taken on line C-C of Fig. 2 (a).

[Fig. 3]

Fig. 3 is a diagram showing an LED drive circuit in the light emitting device in the first embodiment of the invention.

[Fig. 4]

Fig. 4 is a perspective view of the principal part of an assembly comprising the light emitting device in the first embodiment of the invention incorporated into a backlight apparatus.

[Fig. 5]

Fig. 5 is a plan view showing an embodiment of the application of the light emitting device in the first embodiment of the invention to a backlight apparatus.

[Fig. 6]

Fig. 6 is a plan view showing an embodiment of the application of the light emitting device in the first embodiment of the invention to a backlight apparatus.

[Fig. 7]

Fig. 7 is a diagram showing a light emitting device in a second embodiment of the invention, wherein Fig. 7 (a) is a diagram showing the upper surface of the light emitting device, Fig. 7 (b) a cross-sectional view taken on line D-D of Fig. 7 (a), Fig. 7 (c) a diagram showing a metal pattern provided on the upper surface of the light emitting device, and Fig. 7 (d) a diagram showing the lower surface of the light emitting device.

[Fig. 8]

Fig. 8 is a diagram showing a light emitting device in a third embodiment of the invention, wherein Fig. 8 (a) is a diagram showing the upper surface of the light emitting device, Fig. 8 (b) a front view, Fig. 8 (c) a cross-sectional view taken on line E E of Fig. 8 (a), and Fig. 8 (d) a cross-sectional view taken on line F-F of Fig. 8 (a).

[Description of Reference Numerals]

1: light emitting device,

2: printed circuit board,

2a: upper surface,

2b: lower surface,

2c: side face,

3: LED,

3B: blue LED,

3G: green LED,

3R: red LED,

4: case,

4': case,

4a: opening,

5: filling member,

6R, 6G, 6B: separate leads,

6C: common lead,

$6R_1$, $6G_1$, $6B_1$, $6C_1$: electrode faces,

$6R_2$, $6G_2$, $6B_2$, $6C_2$: connections,

$6C_3$: heat radiating section,

7R, 7G, 7B, 8R, 8G, 8B: bonding wires,

9R, 9G, 9B, 10R, 10G, 10B, 10C: through-hole platings,

11, 13: solders,

12: resist,

14: power supply,

15R, 15G, 15B: transistors,

16: control unit,

17R, 17G, 17B: control resistors,

20: backlight apparatus,

21: light emitting device mount substrate,

21a: upper surface of light emitting device mount substrate,

22: wiring pattern,

23: light guide section,

23a: incident face,

23b: outgoing face,

23c: light guide section,

230a: lower surface of light guide section,

230b: upper surface of light guide section,

231: reflection plate,

232: diffusion plate,

e: distance,

L: length, and

W_1, W_2: widths.

[NAME OF DOCUMENT] Abstract

[ABSTRACT]

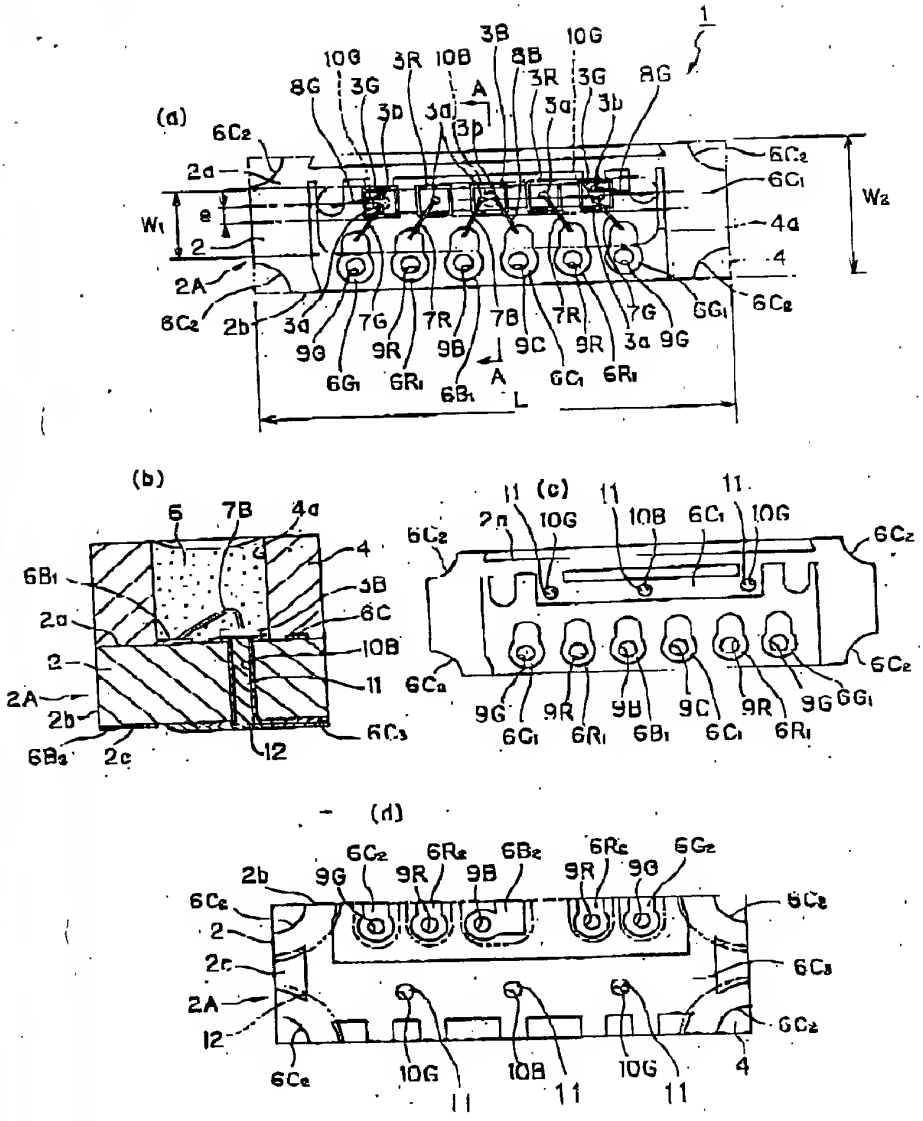
[PROBLEM] To provide a light emitting device in which heat radiating properties are homogenized, heat radiation efficiency is improved, and a compact structure is obtained and, thus, the color balance can be improved and unfavorable phenomena such as lowering in the output of light emitting elements and shortening of the service life can be avoided.

[MEANS FOR SOLVING THE PROBLEM] Separate leads 6R, 6G, 6B and a common lead 6C are provided on the upper surface 2a and lower surface 2c of a base 2. A plurality of LEDs 3R, 3G, 3B are disposed in an array on the common lead 6C on the upper surface 2a of the base 2. The common lead 6C provided on the upper surface 2a of the base 2 is connected to the common lead 6C provided on the lower surface 2c of the base 2 through through-hole plating 10G, 10B. Heat generated from the plurality of LED elements 3R, 3G, 3B is transferred through the common lead 6C provided on the upper surface 2a of the base 2 and the through-hole plating 10G, 10B to the common lead 6C provided on the lower surface 2b of the base 2 and is released therefrom into the air.

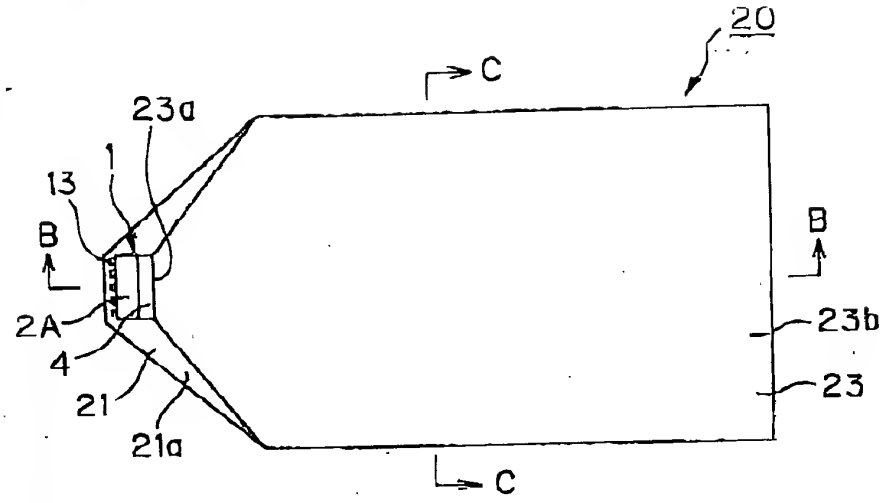
[SELECTED FIGURE] Fig. 1

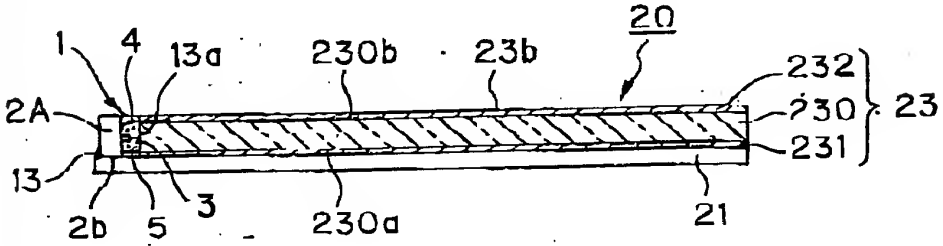
[DOCUMENT] DRAWINGS

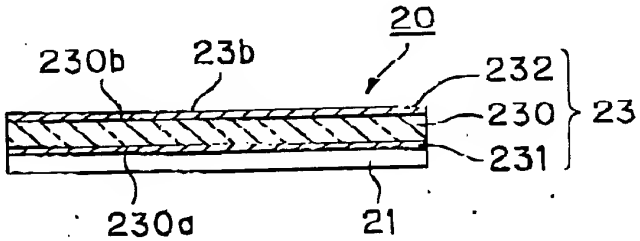
[FIG. 1]



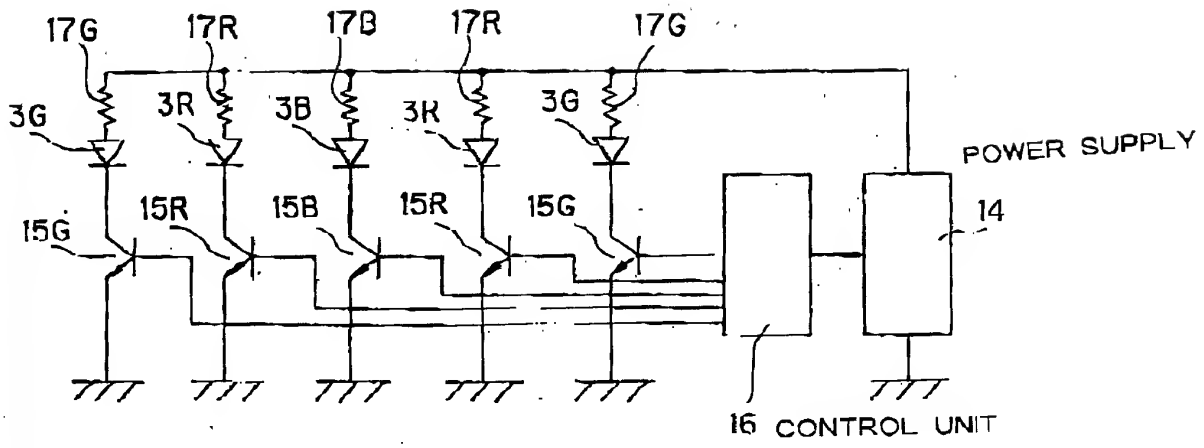
[FIG.2]



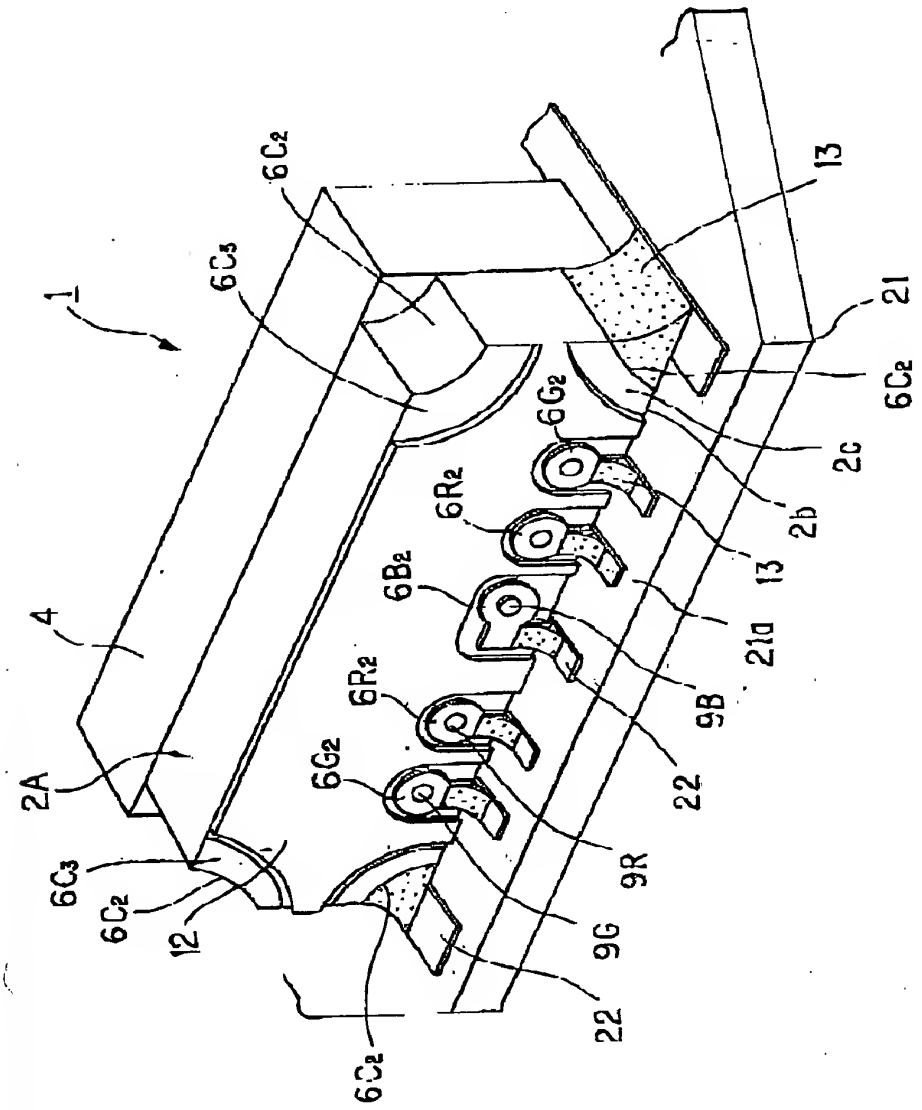




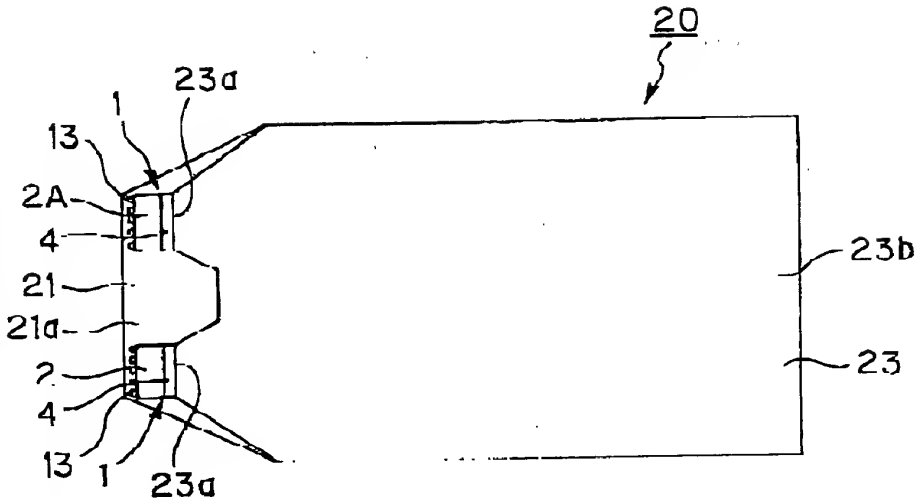
[FIG.3]



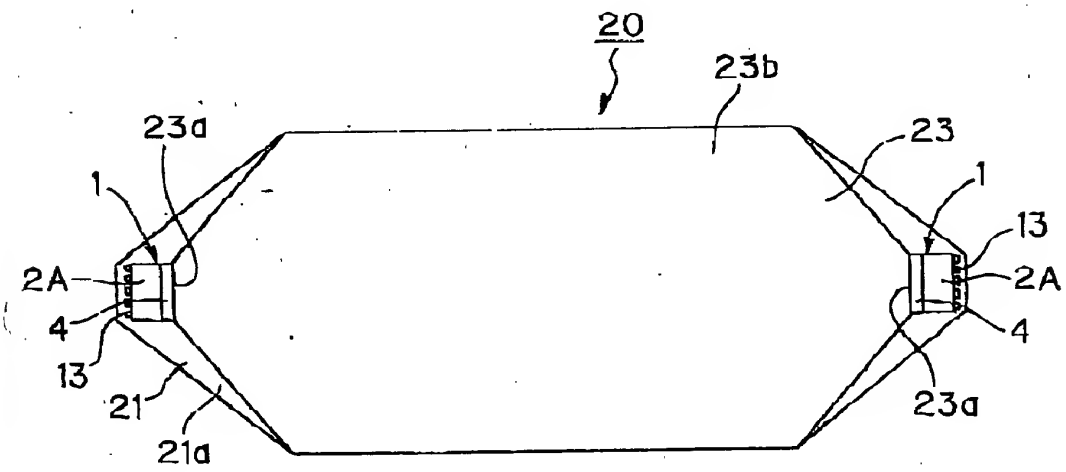
[FIG. 4]



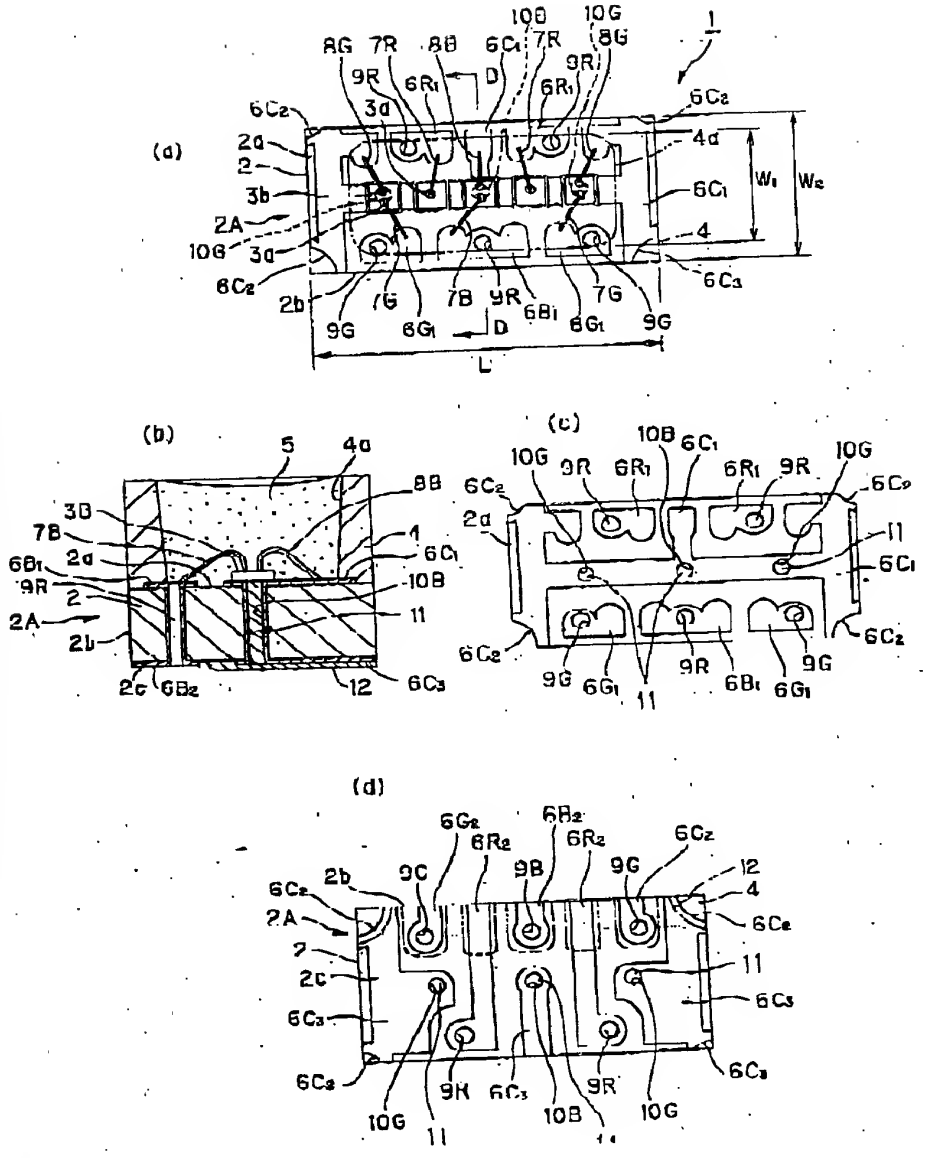
[FIG.5]



[FIG.6]



[FIG. 7]



[FIG.8]